

# Claims

- [c1] 1. A method for starting an engine in a vehicle having a motor and a controller, the method comprising:  
rotating the engine with the motor, thereby increasing engine speed over time and generating an engine speed profile;  
determining whether the engine speed profile matches a predetermined ideal speed profile;  
providing fuel to the engine when the engine speed reaches a target speed and the engine speed profile matches the predetermined ideal speed profile; and  
providing fuel to the engine before the engine speed reaches the target speed when the engine speed profile does not match the predetermined ideal speed profile.
- [c2] 2. The method of claim 1, further comprising:  
determining whether the engine speed has reached a predetermined minimum speed, the predetermined minimum speed being necessary to sustain engine combustion; and  
providing fuel to the engine only when the engine speed is greater than the predetermined minimum speed.
- [c3] 3. The method of claim 1, wherein the predetermined

ideal speed profile is characterized by a line having a constant, positive slope.

- [c4] 4. The method of claim 1, wherein determining whether the engine speed profile matches the predetermined ideal speed profile includes calculating a rate of change of the engine speed over a predetermined time interval and comparing the calculated rate of change to a rate of change for the predetermined ideal speed profile.
- [c5] 5. The method of claim 1, wherein the predetermined ideal speed profile is a calibratable function of time, and wherein determining whether the engine speed profile matches the predetermined ideal speed profile includes comparing a point on the engine speed profile to an expected speed, the expected speed being determined from the predetermined ideal speed profile.
- [c6] 6. The method of claim 1, wherein the vehicle includes a throttle plate and a catalytic converter, and the method further comprises applying an emission minimizing control routine for facilitating a reduction in exhaust emissions by rapidly heating the catalytic converter, the emission minimizing control routine including controlling spark timing, throttle plate position, and an amount of fuel provided to the engine.

[c7] 7. A control system for a vehicle having an engine and a motor, the control system comprising:  
a sensor disposed within the vehicle and configured to measure engine speed and output signals related to the engine speed; and  
a controller in communication with the sensor and configured to command the engine to rotate the motor, thereby increasing engine speed over time and generating an engine speed profile, the controller being further configured to determine whether the engine speed profile matches a predetermined ideal speed profile, provide fuel to the engine when the engine speed reaches a target speed and the engine speed profile matches the predetermined ideal speed profile, and provide fuel to the engine before the engine speed reaches the target speed when the engine speed profile does not match the predetermined ideal speed profile.

[c8] 8. The control system of claim 7, wherein the controller is further configured to determine whether the engine speed has reached a predetermined minimum speed, and to provide fuel to the engine only when the engine speed is greater than the predetermined minimum speed, the predetermined minimum speed being the engine speed necessary to sustain engine combustion.

- [c9] 9. The control system of claim 7, wherein the controller is further configured to calculate a rate of change of the engine speed over a predetermined time interval and to compare the calculated rate of change to a rate of change for the predetermined ideal speed profile, thereby determining whether the engine speed profile matches the predetermined ideal speed profile.
- [c10] 10. The control system of claim 7, wherein the predetermined ideal speed profile is a calibratable function of time, and wherein the controller is further configured to compare a point on the engine speed profile to an expected speed, the expected speed being determined from the predetermined ideal speed profile.
- [c11] 11. The control system of claim 7, wherein the controller comprises:  
an engine control unit for controlling the engine, and connected to the engine through a hardwire interface;  
a transaxle management unit for controlling the motor, and connected to the motor through a hardwire interface; and  
a vehicle system controller in communication with the engine control unit and the transaxle management unit.
- [c12] 12. The control system of claim 11, wherein the vehicle includes a catalytic converter and the engine includes

spark plugs, fuel injectors, and a throttle plate, and wherein the engine control unit is configured with an emission minimizing control routine for facilitating a reduction in exhaust emissions by rapidly heating the catalytic converter, the emission minimizing control routine including controlling spark timing, throttle plate position, and an amount of fuel provided to the engine.

- [c13] 13. A controller for controlling engine startup in a vehicle having a motor, the controller comprising:  
a preprogrammed algorithm for  
a) commanding the motor to rotate the engine, thereby increasing engine speed over time and generating an engine speed profile,  
b) determining whether the engine speed profile matches a predetermined ideal speed profile,  
c) providing fuel to the engine when the engine speed reaches a target speed and the engine speed profile matches the predetermined ideal speed profile, and  
d) providing fuel to the engine before the engine speed reaches the target speed when the engine speed profile does not match the predetermined ideal speed profile.

- [c14] 14. The controller of claim 13, wherein the controller is further configured to determine whether the engine speed has reached a predetermined minimum speed, and to provide fuel to the engine only when the engine

speed is greater than the predetermined minimum speed, the predetermined minimum speed being the engine speed necessary to sustain engine combustion.

- [c15] 15. The controller of claim 13, wherein the predetermined ideal speed profile is characterized by a line having a constant, positive slope.
- [c16] 16. The controller of claim 13, wherein the preprogrammed algorithm is further configured to calculate a rate of change of the engine speed over a predetermined time interval and compare the calculated rate of change to a rate of change for the predetermined ideal speed profile, thereby determining whether the engine speed profile matches the predetermined ideal speed profile.
- [c17] 17. The controller of claim 13, wherein the predetermined ideal speed profile is a calibratable function of time, and wherein the preprogrammed algorithm is further configured to compare a point on the engine speed profile to an expected speed, the expected speed being determined from the predetermined ideal speed profile.
- [c18] 18. The controller of claim 13, further comprising:  
an engine control unit for controlling the engine, and  
connected to the engine through a hardwire interface;  
a transaxle management unit for controlling the motor,

and connected to the motor through a hardwire interface; and  
a vehicle system controller in communication with the engine control unit and the transaxle management unit.